

practicable to give in preceding REVIEWS. While the records show that during June in past years monthly rainfalls of ten inches or more have, in general, been more numerous than in May, the large increase in the amount of data given in this issue is due largely, as stated above, to a more detailed examination of records and to the receipt of additional data.

The south Atlantic states and upper Mississippi and Missouri valleys are the districts that have been most subjected to excessive rainfalls in June, but even in these districts there are many of the older established stations at which the maximum June rainfalls have not reached ten inches. On the north Pacific coast, at Neah Bay, Wash., 10.28 inches of rain fell in June, 1888. There is no record of any previous May or June rainfall equalling this amount on the north Pacific coast, and there is but one instance on record in which it has been exceeded in April, viz., 10.78, at Olympia, Wash., in 1878. The largest monthly rainfall in June of which there is record is 28.86, at Fernandina, Fla., in 1864. East of the Mississippi River the states in which the rainfalls of June have not reached ten inches are the following: Maine, Vermont, Delaware, West Virginia, and Kentucky.

Westward of the one hundredth meridian very few daily rainfalls amounting to 2.50 inches, or more, have been recorded, while to the eastward of the meridian named there is no state in which they have not occurred. These excessive daily rainfalls have been most frequent in the upper Mississippi and Missouri valleys and along the Gulf and Atlantic coasts. In

seventeen years at Galveston, Tex., daily rainfalls exceeding the amount mentioned have occurred eleven times. Nineteen instances of such rainfalls in June at Saint Louis, Mo., are on record, but as the observations at that place cover about half a century, it appears that the west Gulf coast is more frequently subjected to excessive daily rainfalls in this month than any other part of the United States. The fall of 10.70 inches at Pensacola, Fla., for the twenty-four hours ending at 3 p. m. on the 29th, 1887, is the maximum daily amount shown by the records of the Signal Service.

Hourly rainfalls of 1.00 inch or more, like the excessive daily rainfalls, have seldom occurred to the west of the one hundredth meridian. The upper Mississippi and Missouri valleys and south Atlantic coast have been most commonly subjected to rainfalls classed under this heading. Probably one of the most remarkable falls of which there is record is that which occurred at Clear Creek, Nebr., on the 25th, 1882, when there was an actual fall of 3.03 inches in thirty-five minutes; rate per hour 5.22. A fall of 3.95 inches in fourteen minutes (rate per hour, 16.80) is reported to have occurred at Galveston, Tex., on the 14th, 1871, but there is doubt as to the accuracy of the time in which this amount is reported to have fallen. Numerous instances of rainfalls of short duration give a rate per hour in excess of the amounts recorded at Clear Creek and Galveston, but in such cases the actual fall has been small in comparison with that recorded in these two instances in which it exceeded 3.00 inches.

## WINDS.

The most frequent directions of the wind during June, 1888, are shown by arrows flying with the wind. In the Southern States the prevailing winds were southerly; in the extreme northwest and upper Missouri valley, northerly; along the New England and middle Atlantic coast, mostly from east or southeast; in other districts, variable.

### HIGH WINDS (in miles per hour).

The maximum velocity of wind for June, 1888, at Signal Service stations where the movements are registered, are given in the table of miscellaneous meteorological data. Other than the maximum velocities given in this table, the following have been reported: Fort Maginnis, Mont., 60, nw., 4th; 60, nw., 20th; 72, nw., 22d. Fort Canby, Wash., 54, s., 18th.

### LOCAL STORMS.

**1st. Tennessee.**—Memphis: a wind velocity of fifty-four miles per hour was recorded at 9.35 p. m. This storm unroofed numerous buildings and caused damage to boats lying in the river at this place.

**2d. Arkansas.**—Twelve houses in a village in Washington county are reported to have been destroyed by a severe storm on this date. **North Carolina.**—Milton, Caswell Co.: about 4 a. m. a violent and destructive hail storm passed near this place. Its path was about five hundred yards wide and its length about twenty-five miles. Hail of unusual size fell in large quantities, causing great damage to crops; several buildings were destroyed.

**3d. California.**—Red Bluff: a severe thunder-storm, accompanied by rain and hail, passed over this place from south to north between 8.20 and 9.15 p. m. The rainfall in twenty-five minutes amounted to 0.51 inch.

**5th. North Carolina.**—Between 6 and 7 p. m. a storm passed eastward through the central portion of Cumberland county and thence into Sampson county, destroying timber, crops, etc. About the same time a similar storm passed from northwest to southeast through Harnett county.

**6th. Maine.**—Buckfield, Oxford Co.: considerable damage was done in this vicinity by hail and lightning during the evening. Large hail is also reported to have fallen at Mon-

mouth, Kennebec Co. **Massachusetts.**—Boston: severe thunder-storms occurred in the western part of the state. In Berkshire county large trees were uprooted by the wind; much damage was done by lightning at various points. **Ontario.**—Ottawa: the severe storm which occurred in the afternoon lasted nearly an hour and caused a large amount of damage. The wind reached a velocity of 80 miles per hour and in the surrounding country blew down many buildings, among which were a number of school houses; several persons were injured, some fatally. **Quebec.**—Montreal: a storm of unusual severity occurred in the afternoon; damage estimated at \$100,000 was done in this city and in surrounding parishes. In some sections scarcely a barn was left standing. **Vermont.**—Saint Johnsbury, Caledonia Co.: a severe storm, accompanied by hail, occurred about 5 p. m. Much glass was broken by hail and some damage was done by wind. Burlington, Chittenden Co.: some of the largest hail seen at this place for a number of years fell during the severe thunder-storm of this date. Lunenburg, Essex Co.: a severe storm occurred to the west and south of this place about 4 p. m. Several buildings were unroofed, and the country was deluged by heavy rain. In some sections, for miles in extent, the trees were stripped of the leaves by hail and hundreds of them blown down; in an orchard of two acres but two trees were left standing.

**6-7th. New Hampshire.**—Littleton, Grafton Co.: the wind and hail storm during the night was unusually severe and caused much damage.

**7th. Illinois.**—About 3 p. m. a tornado passed in a northeasterly direction near Texas City, Saline Co., causing damage to buildings, orchards, etc. **New York.**—A tornado is reported to have caused considerable damage in the evening at Kingsbury, Washington Co.; a number of dwellings and barns were blown down. **Tennessee.**—Forest Home, Williamson Co.: a very severe hail storm occurred in this vicinity, causing a large amount of damage to wheat which was ready for harvesting. **Texas.**—A "cloud burst," accompanied by hail and high winds, is reported to have occurred in Montague county in the evening. A large area is said to have been submerged, entailing extensive damage.

**8th. Dakota.**—Fort Totten: an easterly gale, during which

the velocity of the wind reached 60 miles per hour, prevailed from 4.39 to 7.10 a. m.

**8-9th. Dakota.**—Fort Yates: a destructive storm passed over this place about 2 a. m. It approached very suddenly and was accompanied by heavy rain. Houses, Indian "tepees," fences, etc., were blown down, and several persons killed by lightning. Reports from Buttzville, Ransom Co., state that at about 3 o'clock a severe hail storm passed over that place, causing great damage to the growing grain. **Kentucky.**—Louisville: it is reported that severe hail storms occurred in the surrounding country and that crops were seriously injured.

**9-10th. Maryland.**—Middletown, Frederick Co.: a destructive storm of wind and hail passed over this section about 3 p. m.; many trees, telegraph poles, etc., were blown down. **Michigan.**—Reports from a number of places in the upper peninsula state that this storm was of unusual severity, and that the very heavy rainfall caused great damage. **New York.**—South Sodus, Wayne Co.: a storm, which appears to have had the characteristics of a tornado, passed through the northern and western portions of this village about 7 p. m. **Virginia.**—Liberty, Bedford Co.: quite a severe hail storm occurred in the afternoon, the hail-stones being the largest observed here in several years. No serious damage resulted. The following is from the "Toledo Blade":

EAU CLAIRE, WIS., June 11—A tornado swept across the country near this place yesterday from the southeast, tearing up the wooded country, but missing the villages. The tornado passed over Lake Chester with great speed, forming a huge water-spout. Some observers say that the column of water was three hundred feet in height.

**12-13th. Wisconsin.**—A very destructive hail storm occurred in the vicinity of Arcadia, Trempealeau Co., during the night, breaking thousands of window panes and causing great damage to crops.

**13th. Dakota.**—Fort Yates: a severe wind storm, accompanied by occasional peals of thunder, occurred during the afternoon; no rain or hail fell at this place, but it is reported that a few miles north of here hail of large size fell. **Ohio.**—Air-Line Junction, Lucas Co.: a violent storm of about fifteen minutes duration occurred in the afternoon, and caused much damage to buildings and other property. Toledo: a very severe and destructive thunder-storm passed over this city in the evening, accompanied by heavy rain and high wind from 7.35 to 7.45 p. m., in which time 0.50 inch of rain fell. The wind blew at the rate of fifty miles per hour. In East Toledo a large building was unroofed and a smoke-stack blown down. Findlay, Hancock Co.: great damage was done to buildings, oil-derricks, and crops in the surrounding country by the storm in the evening. Severe storms also occurred on this date at Tiffin, Bellaire, and Shelbyville.

**13-14th. Dakota.**—During the night a destructive storm occurred in Sargent county. Buildings were blown down or otherwise damaged at Forman and Rutland in the county named.

**14th. Washington.**—Walla Walla: a severe wind storm prevailed between 6.05 and 7 p. m., the wind reaching a velocity of sixty-five miles per hour from the southwest; some buildings were unroofed. **Wisconsin.**—Milwaukee: a severe electrical storm occurred here during the morning. A cable containing about three hundred telephone wires, connecting the eastern and western portions of the city, was burned out, causing suspension of telephonic communication.

**15th. Illinois.**—Oairo: the storm in the afternoon was of unusual severity, the wind reaching a velocity of forty miles per hour from the northwest. The wheat fields in the northern part of this (Alexander) county sustained serious injury. **New York.**—New York City: a severe storm passed over the city during the evening. Much damage was done on Staten Island, and many boats in the harbor were overturned. **Oregon.**—A "cloudburst" is reported to have occurred in the vicinity of Arlington, Gilliam Co., near the Columbia River, about one hundred miles east of Portland. At Lexington, about thirty miles southeast of Arlington, seven buildings are said to have been wrecked.

**16th. New Jersey.**—A violent hail storm is reported to have occurred at Princeton, Mercer Co., the hail-stones being of sufficient size to break windows. **Virginia.**—Dale Enterprise, Rockingham Co., ten miles east of this place, the wheat and corn crops were almost entirely destroyed by hail in the afternoon. Hail of considerable size fell at Dale Enterprise at 4.30 p. m.

**17th. Texas.**—Galveston: heavy rain and high wind prevailed at intervals from 3.30 a. m. until 8 p. m., the highest velocity being fifty-four miles per hour at 12.25 p. m. The rainfall for sixteen hours was 6.40 inches.

**18-19th. Wisconsin.**—Buildings and crops in the vicinity of Neenah, Winnebago Co., were considerably damaged by a storm during the night.

**19th. Kansas.**—Dodge City: at 4 p. m. the wind suddenly veered from southeast to north, and the temperature fell 23° in half an hour. Very heavy rain began 4.15 and ended 5 p. m., the total in forty-five minutes being 3.24 inches. The capacity of the city's sewers was insufficient to carry off the great volume of water, and a large amount of damage was done by the flooding of basements and cellars. The wind attained a velocity of forty-eight miles per hour. About two miles northwest of the city a barn and two wind-mills were overturned. Both west and east of here the storm was equally as severe. Cawker City, Mitchell Co.: at 5.15 p. m. a tornado passed through the southwest portion of this town, destroying several buildings. **Montana.**—Fort Maginnis: a moderate thunder-storm, moving from southwest to northeast, prevailed from 9.45 a. m. to 12.50 p. m. Six miles southwest of this place the storm was accompanied by hail of large size, which covered the ground to the depth of two inches, and caused much damage to crops and window-glass. The path of the hail storm was about six hundred yards wide. **Wisconsin.**—White Water, Walworth Co.: a severe wind and hail storm passed over the western portion of this town about 3.30 p. m.; the hail-stones were of extraordinary size and fell thickly for a short while.

**21st. Illinois.**—Springfield: an unusually severe rain storm prevailed from 1.22 to 4.50 p. m., during which time 2.71 inches of water fell, which the sewers were inadequate to carry off. The cellars in some portions of the city were flooded to a depth of several feet. **Indiana.**—Terre Haute: about 4 p. m. a storm caused considerable damage of minor nature in the southern part of this place. **Montana.**—Fort Maginnis: a very violent storm of wind and rain occurred this date, the wind reaching a velocity of eighty-four miles per hour. The total rainfall for the storm, as measured, amounted to 3.18 inches, but on account of the high wind this amount was doubtless much less than the actual fall, which the observer estimated at from eight to ten inches. The wind velocity and rainfall accompanying this storm are without precedent since the establishment of the station. Great damage was done to crops, buildings, etc., in the surrounding country.

**23d. New Jersey.**—In the afternoon a severe local storm, accompanied by hail, passed over Gloucester City, Camden Co., unroofing several buildings. **Pennsylvania.**—Violent electrical storms, accompanied by very heavy rain, and in some places by hail, occurred both in the morning and afternoon in the vicinity of Pittston, Luzerne Co. A severe storm also occurred at Pottsville, Schuylkill Co., the very heavy fall of rain causing much damage by flooding basements and cellars.

**24th. New York.**—A tornado occurred in the vicinity of Aurelius Station, Cayuga Co., between 4 and 5 p. m. It pursued a course slightly to the north of east, causing damage to several buildings. **Texas.**—Cisco, Eastland Co.: several houses were blown down by a storm which occurred in the afternoon.

**26th. Alabama.**—Snow Hill, Wilcox Co.: the corn and cotton crops in the eastern part of this county were much injured by a severe storm. Reports from Troy, Pike Co., and Childersburg, Talladega Co., state that the storm was also destructive at those points.

**27th. Georgia.**—Severe local storms prevailed in southern

Georgia on this date, causing damage to crops, outbuildings, etc. *Kentucky*.—Reports from Todd and Muhlenburg counties state that a destructive storm, moving northwest to southeast, passed through those counties, blowing down buildings, etc. *Montana*.—Fort Custer: a thunder-storm passed over this place between 5 and 6 p. m. Hail fell from 5.23 to 5.27 p. m., the average size of the hail-stones being one and one-half inches in diameter, although some were much larger. Horses

and cattle exposed to the storm were badly hurt by the hail. More than 1,000 window panes were broken.

**28th. North Carolina**.—A severe local storm, the most violent part of which lasted less than one minute, occurred about 2.30 p. m. at Laurinburg, Richmond Co.; some buildings were blown down and others unroofed. Powelton, Richmond Co.: during the afternoon several buildings were unroofed or otherwise damaged by a severe storm.

### INLAND NAVIGATION.

#### STAGE OF WATER IN RIVERS AND HARBORS.

In the following table are shown the danger-points at the various stations, the highest and lowest depths for June, 1888, with the dates of occurrence and the monthly ranges:

*Heights of rivers above low-water mark, June, 1888 (in feet and tenths).*

Stations.	Danger-point on gauge.	Highest water.		Lowest water.		Monthly range.
		Date.	Height.	Date.	Height.	
<i>Red River:</i>						
Shreveport, La. ....	29.9	1	24.7	24 to 27	19.0	5.7
<i>Arkansas River:</i>						
Fort Smith, Ark. ....	22.0	11	16.3	8	4.5	11.8
Little Rock, Ark. ....	23.0	14	16.5	10, 11	6.2	10.3
<i>Missouri River:</i>						
Omaha, Nebr. ....	18.0	30	16.3	8, 11	11.5	4.8
Leavenworth, Kans. ....	20.0	30	17.9	10	14.4	3.5
<i>Mississippi River:</i>						
Saint Paul, Minn. ....	14.5	1	10.8	10, 29, 30	7.6	3.2
La Crosse, Wis. ....	24.0	1	13.0	13, 14	9.9	3.1
Dubuque, Iowa ....	16.0	2, 3	16.4	18, 19, 20	11.9	4.5
Davenport, Iowa ....	15.0	4, 5	12.9	21, 22	9.0	3.9
Keokuk, Iowa ....	14.0	1	15.2	30	9.1	6.1
Saint Louis, Mo. ....	32.0	3, 4	29.3	15	23.2	6.1
Cairo, Ill. ....	40.0	6	32.4	17	24.0	8.4
Memphis, Tenn. ....	34.0	8	27.0	19	20.4	6.6
Vicksburg, Miss. ....	41.0	12, 13, 14	34.9	30	28.8	6.1
New Orleans, La. ....	13.0	13, 14	12.2	30	10.3	1.9
<i>Ohio River:</i>						
Pittsburg, Pa. ....	22.0	30	7.0	15, 16	2.0	5.0
Cincinnati, Ohio ....	50.0	5	19.2	27	6.5	2.7
Louisville, Ky. ....	25.0	6	8.1	25	4.0	4.1
<i>Cumberland River:</i>						
Nashville, Tenn. ....	40.0	30	11.9	27	2.1	9.8
<i>Tennessee River:</i>						
Chattanooga, Tenn. ....	33.0	3	9.2	27	2.8	6.4
<i>Monongahela River:</i>						
Pittsburg, Pa. ....	29.0	30	7.0	15, 16	2.0	5.0
<i>Savannah River:</i>						
Augusta, Ga. ....	32.0	1	16.9	26, 27, 28	7.0	9.9
<i>Willamette River:</i>						
Portland, Oregon ....		18 to 22	18.2	1	11.8	6.4

The Signal Service observer at Nashville, Tenn., reports that the rains from the 25th to 28th caused the Cumberland River to rise sufficiently to permit the resumption of navigation, which had been almost entirely suspended on account of low water.

#### FLOODS.

Bar Mills, York Co., Me.: the Saco River at this place was at a very high stage on the 3d. A mill at Hollis was washed away during the evening of the 2d.

New Orleans, La.: nearly three inches of rain fell in one hour and forty minutes on the afternoon of the 6th, causing the inundation of several streets. Another heavy rainfall occurred on the 26th, when about 4.50 inches fell. Between 8 and 9 p. m. a large part of the city was submerged.

Vinita, Cherokee Nation, Ind. T.: a "cloud-burst" occurred near here during the morning of the 10th, flooding the country, and washing away several bridges.

Aitken, Aitken Co., Minn.: the heavy rainfall during the night of the 13-14th caused the inundation of a part of this place, compelling many families to leave their homes.

The "Toledo Blade" of the 12th contained the following, which also appeared in numerous other papers.

DULUTH, MINN., June 12.—The recent severe rains have caused the greatest flood ever known in northern Minnesota. Along the branches of streams tributary to the Saint Louis River millions of acres of land are overflowed and loss of life is feared. At the village of Cloquet, thirty miles from here, that portion of the town which is situated on the island is completely engulfed by a raging torrent. Only the tops of houses are visible. Several dwellings

have been carried away, but the inhabitants were warned in time, and no loss of life occurred. The immense saw mills are flooded and abandoned, and in the booms 80,000,000 logs were jammed yesterday morning, and the number reached 200,000,000 last night. All county bridges have been carried away. Fond du Lac, sixteen miles from here, is under water, and several buildings have been carried down stream. From Fond du Lac to beyond Spring Lake the tracks of the Saint Paul and Duluth Railway are under water from two to three feet, and the stream is still rising. Indians and old settlers say the flood has never been equalled.

Titusville, Crawford Co., Pa.: during the night of the 15-16th there was a very heavy fall of rain, which caused Oil Creek to rise seven feet in about an hour. Buildings were moved from their foundations and bridges were swept away. In the surrounding country great damage was done.

Collinsville, Madison Co., Ill.: the heavy rainfall during the night of the 15-16th damaged property in this vicinity to a considerable extent.

Carrollton, Carroll Co., Mo.: the very heavy rainfall during the night of the 15-16th caused Wakenda Creek to overflow about twenty square miles of the adjacent lowlands. Extensive washouts occurred on the railroads in this section. At Chillicothe, Livingston Co., the rainfall was remarkably heavy, and the lower floors of store rooms, etc., were flooded, causing much damage.

Saint Louis, Mo., 16th: from 12.45 a. m. to 11.48 a. m., 4.50 inches of rain fell, this being the heaviest fall recorded here since the establishment of the signal station in November 1870. In several places there were washouts around the sewer vents. That portion of the city in the vicinity of Cass avenue and Twenty-second street was overflowed in the morning, the sewers being inadequate to carry off the rainfall, but no particular damage was done. Reports from Norborne, Carroll Co., Mo., state that much stock was drowned in that vicinity.

Fort Buford, Dak.: the river overflowed in some places in this vicinity on the 23d.

Fort Stanton, N. Mex.: a very heavy rainfall occurred a few miles west of this place on the 18th. A small stream running through Fort Stanton rose to an unusual height in a very short time. Many bridges and fences were washed away and farms and gardens were damaged.

Mobile, Ala.: light rain began at 11.20 p. m. 25th and continued throughout the 26th, falling very heavy at intervals; the total fall for the twenty-four hours ending at 10 p. m. was 4.63 inches. On the morning of the 27th there was another very heavy fall of rain, amounting to more than six inches.

Leavenworth, Kans.: from 12.08 until 4.20 p. m. 26th 2.50 inches of rain fell. The sewers and culverts were unable to carry off the water and nearly all the cellars in the business portions of the city were flooded. Three-Mile creek, which passes through the city, overflowed and did considerable damage to the Fifth street bridge. All railroads leading into the city suffered from washouts, and trains were delayed in consequence.

Tuscola, Douglass Co., Ill.: the very heavy rainfall during the night of the 26-27th flooded the southern part of this town to such an extent as to compel about fifteen families to abandon their dwellings. It is estimated that about 10,000 acres of corn in this county were submerged.

#### HIGH TIDES.

Galveston, Tex., 17th. Calais, Me., 27th.